

Psychosocial factors in pregnancy and birthweight: Path analysis

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Abstract

Aim: Birthweight is known to be affected by several factors. In the present study a relationship model of psychological and economic determinants of birthweight was designed and tested.

Methods: This prospective study involved 400 pregnant women in four districts of Tehran, Iran. The subjects were selected through a multistage sampling method. Seven questionnaires (socioeconomic status; Holmes and Rahe Stress Scale; Perceived Stress Scale; 21-item Depression, Anxiety, and Stress Scale [DASS-21]; perceived social support; pregnancy-related anxiety scale; and domestic violence questionnaire) were used to assess participant psychosocial and economic conditions. In order to collect post-partum information about the mother and the infant, the women were followed up until delivery. Data were analyzed using SPSS-16 and Lisrel-8.8.

Results: Based on the obtained path diagram, the greatest adverse effects on birthweight were exerted directly by DASS-21 score ($B = -0.14$) and indirectly by stressful life events ($B = -0.037$). Among variables that affected birthweight in both paths, socioeconomic status and perceived stress had the strongest overall effects on birthweight ($B = 0.203$ and -0.1024 , respectively).

Conclusion: According to the path analysis model, psychosocial and economic factors can directly/indirectly affect birthweight.

Key words: birthweight, path analysis, psychosocial factor.

Introduction

Birthweight is one of the most common and feasible indicators of infant health. This parameter alone is the most important factor in neonatal and post-neonatal mortality.¹ Many clinical and epidemiological studies and health interventions have been conducted to identify the determinants of and prevent low birthweight (LBW).²

Low birthweight, defined as birthweight <2500 g by the World Health Organization (WHO),³ has a global prevalence of 15.5%. Of approximately 20.6 million LBW infants born every year, 96.5% are in developing countries.^{4–6} The United Nations Children's Fund (UNICEF) has estimated the prevalence of LBW in Iran during 2005–09 at 7%. Systematic reviews for 1991–2010 have also suggested similar rates in the country.^{7,8} LBW has been found to be associated with not only

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a 44-fold higher risk of mortality compared with normal weight infants,^{5,9} but also various complications, such as suppressed motor, cognitive, and social development, in infancy, childhood, and adulthood. Hence, in order to achieve the fourth Millennium Goal (reducing child mortality by two-thirds), it is essential to decrease the rate of LBW.⁵

Several factors, commonly categorized as fetal, placental, environmental, and maternal, are associated with LBW.¹⁰ Although strenuous efforts to control the involved biological factors have been able to successfully reduce various health indicators (such as infant mortality) over the past two decades, the prevalence of LBW has remained constant, or has even increased in some countries.¹¹ Therefore, the role of other factors, especially that of social factors and health promotion strategies, needs to receive greater attention.¹² Based on the conceptual framework developed by the WHO Commission on Social Determinants of Health, psychosocial circumstances including psychosocial stressors, stressful living circumstances and relationships, anxiety, depression, and lack of social support are among the major determinants of health.¹³

Little knowledge is available about the effects of psychopathological factors on pregnancy outcomes,¹⁴ but prenatal psychopathologies (e.g. depression and anxiety) or psychological stresses (e.g. separation and death of spouse or a loved one) are regarded as risk factors of adverse pregnancy outcomes such as preterm birth, intrauterine growth restriction, low Apgar score, gestational hypertension, and pre-eclampsia.^{15,16} These factors have direct/indirect effects by preventing pregnant women from paying adequate attention to their own health or that of their infant.^{17–22} Social support, in contrast, acts as a psychosocial mediator between stress and its manifestations. Although it is negatively associated with stress, it has a positive association with adaptation.²³ Socioeconomic inequalities can also affect neonatal health and pregnancy outcome.²⁴ Research has proven numerous socioeconomic factors such as low education level and socioeconomic status and low/high maternal age to be correlated with preterm delivery and LBW. Socioeconomic status is thus accepted as a critical determinant of health and mortality.²⁵

Psychosocial stress in pregnancy, defined as the imbalance felt by a pregnant woman when dealing with behavioral and physiological demands, has been rarely investigated in midwifery studies. While the exact prevalence of prenatal psychosocial stressors is unknown,²⁶ approximately 25% of pregnant women are believed to experience some sort of psychosocial stress.²⁷ Previous

studies have, however, failed to establish a relationship between psychosocial stress and LBW.²⁸ A meta-analysis, for instance, reported a weak relationship between psychosocial stress during pregnancy and both infant weight and LBW risk. In contrast, a meta-analysis of 50 articles indicated the absence of a link between symptoms of prenatal depression and adverse pregnancy outcome.²⁷ Newborn size at birth reflects two factors: length of gestation and fetal growth. Therefore, it should be considered in terms of gestational age, otherwise the increase in size that occurs with aging can interfere in the expression of fetal growth. Accordingly, in the present study infants weighing <2500 g and born before 37 weeks of gestation are referred to as preterm and low birthweight.⁴

Due to the contradictory results of previous studies and the importance of diagnosis and treatment of prenatal psychosocial stress in reducing pregnancy complications and adverse outcomes, the aim of the present study was to investigate the relationships between psychosocial factors and LBW.

Methods

In this prospective study a model of the relationships between psychological, socioeconomic determinants of birthweight was designed and tested.

Sampling method and sample size calculation

Based on a review of the relevant literature and considering the 10% prevalence of preterm delivery, the research variables, the number of items in each scale, and the key concepts, 3–10 participants per variable seemed essential.²⁹ Accordingly, a multistage sampling method was adopted to recruit 400 eligible pregnant women living in Tehran (Iran). In the first stage, that is, stratified sampling, Tehran was divided into four geographical strata (north, south, east, and west). Cluster sampling was then applied to select a number of clusters (one or two public hospitals) from each stratum. Finally, simple random sampling was used to select eligible women from each cluster.

Overall, 18–40-year-old women who presented at the selected hospitals in Tehran were included if they had singleton pregnancy, gestational age between 24 and 32 weeks (based on the first day of the last menstrual period or ultrasound), no history of known prenatal medical issues (e.g. cardiovascular disease, diabetes, renal or pulmonary disease, or autoimmune disease), and no history of pre-eclampsia, diabetes, premature rupture

of membranes, placental abruption, or polyhydramnios during past pregnancies.

Procedures

After obtaining necessary permissions, 400 eligible women had the study objectives explained to them, and were asked to provide written consent. The recruited women were then interviewed, and demographic and obstetric characteristics recorded. Questionnaires were distributed among the participants during their visits to the prenatal departments. All items of all questionnaires were read to illiterate women and their responses were marked. The subjects were followed up until delivery, and postnatal information (on both the mother and the infant) was collected.

Measures

The following seven questionnaires were used to collect data.

Socioeconomic status questionnaire

A researcher-made questionnaire containing items on the pregnant woman's and spouse's education level, area of the dwelling (per person), price of the dwelling (per square meter), and facilities was used to assess socioeconomic status.³⁰

Pregnancy-related anxiety scale

A scale developed by Salari *et al.* was utilized to measure pregnancy-related anxiety. It contained 51 items arranged in six subscales including health, others' perception of the respondent, and religious, financial, environmental, and personal/family factors. Each item was scored on a 5-point Likert scale from 1 (not at all) to 5 (very much). The total scores hence ranged between 51 and 255.³¹

Holmes and Rahe Stress Scale

The Holmes and Rahe Stress Scale provide a list of 43 stressful life events that have dramatically changed the person's life over a 1-year period. The scores reflect the respondents' level of stress, that is, total score <150, 150–200, 200–300, and >300 suggest low stress (good mental health), moderate stress (37% risk of illness during the year), high level of stress (50% risk of illness), and very high level of stress (80% risk of illness), respectively.^{32–34}

Perceived Stress Scale

The Perceived Stress Scale (PSS) was developed by Cohen *et al.* in 1983.²⁰ It has been widely used to assess general perceived stress over a 1-month period. A 14-item

version of the PSS (PSS-14), containing seven negative items (indicating inability to cope with stress) and seven positive items (indicating good ability to cope with stressful events),³⁵ was used in the current study. The participants were asked to check the most relevant choice on a 5-point Likert scale (from 1, never; to 5, very often). The minimum and maximum total scores of the scale were 0 and 56, respectively. Higher scores indicated greater perceived stress. Content validity measurements have suggested moderate correlations between the PSS and other stress assessment scales.³⁶ Moreover, three studies have confirmed the reliability of the PSS (Cronbach's alpha, 0.84–0.86).³⁷

Multidimensional Scale of Perceived Social Support

This 12-item measure of perceived support was introduced by Zimet *et al.* in 1988.⁶³ Each item is scored on a 7-point Likert scale from 1 (very strongly disagree) to 7 (very strongly agree). Total scores range between 12 and 84. Score 13–48, 49–68, and 69–84 indicates poor, moderate, and high social support, respectively. Various studies have verified the content validity and reliability (Cronbach's alpha, 0.86) of this scale.^{38–41}

21-item Depression, Anxiety, and Stress Scale

The 21-item Depression, Anxiety and Stress Scale (DASS-21) consists of three seven-item subscales to evaluate anxiety, depression, and stress symptoms. Items are scored on a 4-point Likert scale from 0 (did not apply to me at all) to 3 (applied to me very much or most of the time). Score 1–7, 8–14, and 15–21 in each subscale, respectively, suggest mild, moderate, and severe levels of the measured negative emotional state. Numerous Iranian and foreign studies have used the DASS-21 and confirmed its validity and reliability.⁴²

Domestic violence questionnaire

In the present study, domestic violence was limited to partner violence during pregnancy. The questionnaire developed by the WHO was used to measure domestic violence. The questionnaire consisted of physical, sexual, and emotional violence sections (nine, eight, and 15 questions, respectively). All items were scored on a 5-point Likert scale. Pregnant women with at least one affirmative answer to the questions in each section were considered to have been subjected to partner violence. Previous studies in Iran have reported Cronbach's alpha for physical, sexual, and emotional sections of the questionnaire as 0.92, 0.88, and 0.89, respectively.⁴³

This study was approved by the Ethics Committee of Shahid Beheshti University of Medical Sciences, Tehran.

The conceptual path model was developed by review of articles and textbooks and group meetings with experts in the fields of gynecology, psychiatry, reproductive medicine. The ultimate goal in this study was to evaluate the fitness of a conceptual path model (Fig. 1) for determining correlations between maternal psychosocial characteristics during pregnancy and LBW. In this study, path analysis, that is, an extension of the regression model, was used. Standardized regression coefficients indicate the direct effect of independent parameters on dependent parameters, when a cause and effect relationship, instead of an unreal or random relationship, is considered among a series of variables, especially when there is also a logical relationship between sequential variables; path analysis is recommended for statistical analysis.⁴⁴ Path analysis enables identification of both direct and indirect paths, as well as overall effects of relationships between variables. Also, effects of independent variables on dependent ones can be shown by drawing a diagram from left to right, respectively.⁴⁵

Statistical analysis

In relation to fitness indices of models in path analysis, chi-squared to degree of freedom index ($\chi^2/\text{d.f.}$) <3 is preferred, even though some consider a score of 4 and even 5 to indicate a good fit. Other indices for fitting the model include the normed fit index, comparative fit index, and the goodness of fit index, with preferred values >0.9.²⁹ In the root mean square error of approximation criteria, score ≤ 0.05 indicates a good fit, and up to 0.08 is acceptable, although some sources consider a score up to 0.11 acceptable.⁴⁶ SPSS-17 and Lisrel-8.8 software were used for data analysis with the application of path analysis.

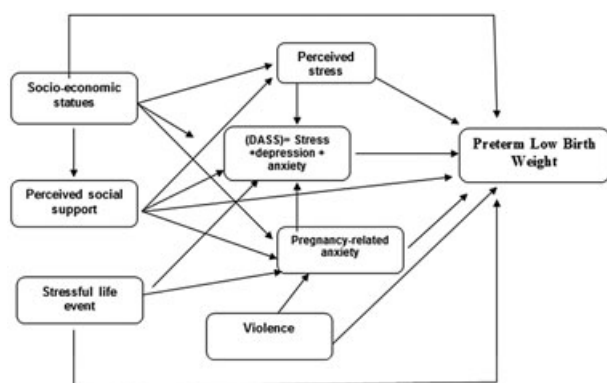


Figure 1 Conceptual framework. DASS, Depression, Anxiety and Stress Scale.

Results

Of the 453 recruited women, 400 were examined (Fig. 2), 86 of whom gave birth to LBW infants (others had normal weight infants). Normal distribution of variables was confirmed on Kolmogorov–Smirnov test. Women with LBW or normal weight infants had no significant differences in terms of age, frequency of receiving prenatal care, or spouse education level (Table 1).

Prior to path analysis, bivariate analysis was used to assess the existing correlations between variables. As seen in Table 2, socioeconomic factors had the highest direct correlation with LBW. Moreover, DASS-21 scores had the strongest inverse correlation with LBW.

The effects of socioeconomic status, perceived stress, perceived social support stress during pregnancy, DASS stressful life event and violence on LBW were investigated in path analysis (Fig. 3).

According to the developed path diagram, the greatest adverse effects on LBW were exerted by the DASS-21 scores ($B = -0.14$) among direct paths and stressful life events ($B = -0.37$) among indirect paths. Unlike other variables, these two variables affected LBW through a single (direct or indirect) path. Consequently, mothers with unfavorable DASS-21 score or history of stressful life events gave birth to infants with lower weight. Moreover, only two variables (socioeconomic status and perceived stress) affected LBW through both paths. Socioeconomic status had affected LBW not only directly ($B = 0.16$), but also indirectly through perceived stress ($B = -0.2$), perceived social support ($B = 0.13$), and DASS-21 score ($B = -0.21$). Such effects were positive and had an overall correlation with LBW ($B = 0.203$). Hence, mothers with favorable socioeconomic status had higher weight infants. In contrast, perceived stress had a negative effect on LBW ($B = -0.1024$). It affected LBW both directly ($B = -0.01$) and indirectly through its effects on DASS-21 score ($B = 0.66$; Table 3).

Fit indices confirmed the model fitness and logical relationships between the variables according to the conceptual model. In other words, the fitted model had no significant differences with the conceptual model (Table 4).

Discussion

Based on path analysis, socioeconomic status and perceived stress had the greatest overall effect on birthweight. Socioeconomic status affected birthweight both positively (directly and indirectly through

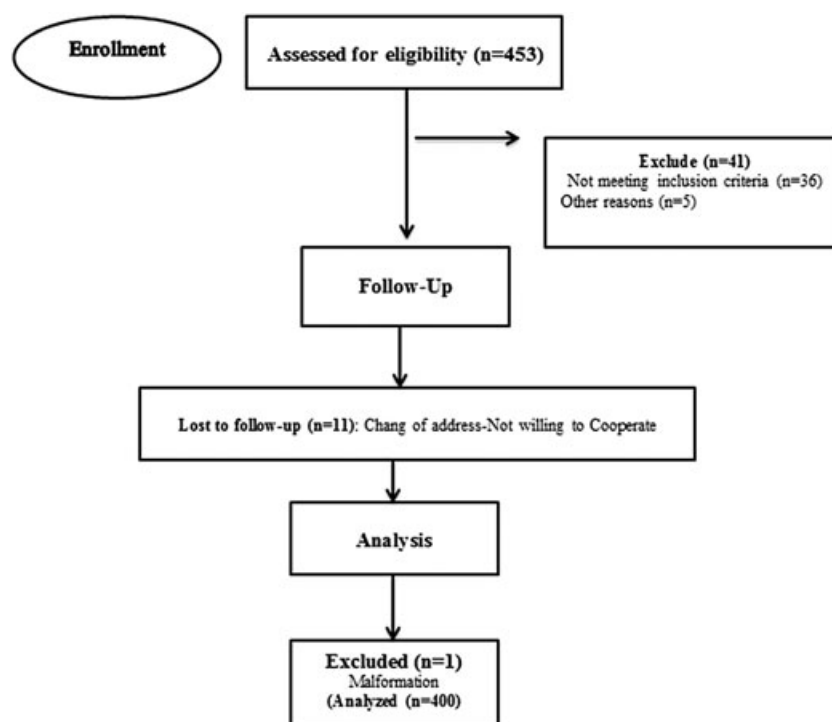


Figure 2 CONSORT flow diagram.

perceived social support) and negatively (indirectly through perceived stress and DASS-21 scores). Similarly, Zarbakhsh-Bhari *et al.* concluded that families of LBW infants were in lower socioeconomic strata compared with families of normal weight infants.⁴⁷

Poor socioeconomic conditions are believed to increase the risk of improper health behaviors, inadequate

access to prenatal care, and malnutrition, drug abuse, anemia, and other health issues in mothers. This will in turn promote the risk of pregnancy complications such as miscarriage, stillbirth, and preterm delivery. Significant relationships of poor housing, maternal low education level, and low income with preterm delivery and LBW have also been documented in previous

Table 1 Subject characteristics

Neonatal Variable	PLBW Mean \pm SD	Normal Mean \pm SD	<i>P</i> -value
Maternal age (years)	28.45 \pm 4.87	28.32 \pm 4.8	0.32
Paternal age (years)	32.47 \pm 5.57	32.84 \pm 5.27	0.57
Maternal education (years)	10.56 \pm 3.41	11.69 \pm 3.07	0.007
Paternal education (years)	10 \pm 3.02	11.19 \pm 3.2	0.002
BMI (kg/m ²)	24.69 \pm 4.7	25.43 \pm 4.8	0.20
Maternal height (cm)	163.24 \pm 7.9	165.72 \pm 5.3	0.45
Paternal height (cm)	172.33 \pm 5.3	171.48 \pm 4.8	0.27
Maternal weight gain during pregnancy (kg)	8.34 \pm 4.8	9.72 \pm 3.9	0.36
Blood pressure (mm/hg)	11.87 \pm 3.9	12.22 \pm 4.5	0.75
Residence area (m ²)	28.07 \pm 15.95	27.72 \pm 12.54	0.68
Socioeconomic status	16.77 \pm 4.57	18.94 \pm 5.30	0.001
Perceived stress	23.83 \pm 6.66	21.44 \pm 8.60	0.018
Perceived social support	59.32 \pm 12.14	60.77 \pm 13.70	0.376
Pregnancy-related anxiety	1.44 \pm 34.55	1.34 \pm 36.49	0.018
Stressful life event	1.11 \pm 118.19	1.001 \pm 89.35	0.323
DASS Stress +depression + anxiety	21.09 \pm 12.09	16.55 \pm 11.08	0.001

BMI, body mass index; DASS, Depression, Anxiety and Stress Scale; PLBW, preterm and low birthweight.

Table 2 Correlations between structural and intermediary determinants of health and PLBW

	Socioeconomic status	Perceived social support	Perceived stress	PLBW	Stressful life event	(DASS)= Stress + depression + anxiety	Pregnancy-related anxiety	Violence
Socioeconomic status	1							
Perceived social support		0.260**	-0.141**	0.193**	0.132**	-0.207**	-0.078	-0.125*
Perceived stress		1	-0.349**	0.063	-0.123*	-0.360**	-0.038	-0.085
PLBW			1	-0.122*	0.386**	0.570**	0.092	0.054
Stressful life event				1	-0.006	-0.184**	-0.114*	-0.081
(DASS)= Stress + depression + anxiety					1	0.228**	-0.028	-0.055
Pregnancy-related anxiety						1	0.034	0.052
Violence							1	0.164**
								1

* $P < 0.05$; ** $P < 0.01$. DASS, Depression, Anxiety and Stress Scale; PLBW, preterm and low birthweight

research.^{19,48–50} In epidemiological studies socioeconomic status was found to influence nutritional knowledge and food quality. Mothers with higher nutritional knowledge decrease their risk of adverse pregnancy outcomes, including LBW, by having a better diets (in terms of both quantity and quality).⁵¹ In contrast, socioeconomic status indirectly improved birthweight and gestational age at birth by affecting social support, stress, anxiety, depression, and domestic violence (which in turn influenced pregnancy-related anxiety and prenatal care status).⁵² Mothers with better socioeconomic status had greater social support and lower levels of stress, anxiety, and depression. Several studies have reported the association between infant development and family and social support, that is, the latter has been proved to play a critical role in improving pregnancy outcomes by promoting healthy lifestyle and behaviors, adequate prenatal care, and biological mechanisms (e.g. lower maternal stress reactions).^{53–55}

Relationships between psychological factors (e.g. prenatal stress, anxiety, and depression) and adverse pregnancy outcomes (e.g. LBW and preterm delivery) have been well documented.^{56,57} Stress affects pregnancy outcomes via both behavioral and physiological mechanisms. While the behavioral mechanism involves unhealthy lifestyle and behaviors, for example smoking, drug abuse, and sedentary lifestyle, the physiological mechanisms refer to high maternal stress and the neuro-hormonal systems of the mother and the fetus.^{10,55}

Stressful life events were found to have negative effects on birthweight. This effect was exerted through a single indirect path. As a result, women who had various stressful life events such as homelessness, death of a first-degree relative, divorce, dismissal from work, and domestic violence during pregnancy were more likely to have LBW infants. Such a likelihood has been reported to increase with higher frequency of stressful events.^{58–60} As discussed earlier, stress affects lifestyle behaviors. For instance, the number of stressful events has an inverse relationship with cessation of smoking.⁶¹

The present study has highlighted direct/indirect relationships between LBW and socioeconomic status, social support, and psychological factors. The theory of social causation implies that social class and lifestyle contribute to the development of psychological disorders. In other words, although all individuals may experience various stressful events, these events cause dissimilar levels of stress in different social classes, that is, lower classes are at higher risk of developing psychological disorders and the subsequent complications.⁶²

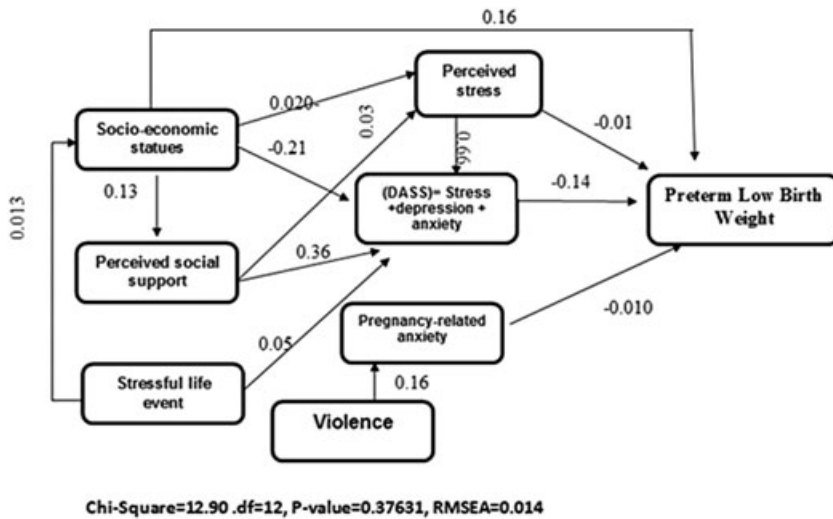


Figure 3 Full empirical model (empirical path model for effects of structural and intermediary determinants of health on preterm low birthweight. $\chi^2 = 12.90$; d.f. = 12; $P = 0.37631$; RMSEA = 0.014.

Table 3 Goodness of fit indices ($n = 400$)

Model index	χ^2	d.f.	RMSEA	GFI	NFI	CFI
	12.9	12	0.014	0.99	0.99	0.99

CFI, comparative fit index; GFI, goodness of fit index; NFI, normed fit index; RMSEA, root mean square error of approximation.

Table 4 Path coefficients

Predictor variables	Effect			Model Coefficient	T-Value
	Direct	Indirect	Total		
Socioeconomic status	0.16	0.043328	0.203328	21.11	3.13
Pregnancy-related anxiety	-0.10	—	-0.10	-1.89	-2
Perceived stress	-0.01	-0.0924	0.1024	-0.84	1.97
Perceived social support	—	-0.0504	-0.0504	—	—
(DASS)= Stress + depression + anxiety	-0.14	—	-0.14	0.0054	-2.39
Stressful life event	—	-0.03737536	-0.03737536	—	—
Violence	—	-0.016	-0.016	—	—

DASS, Depression, Anxiety and Stress Scale.

Thus, due to the importance of childhood, relevant policies need to be adopted to promote childhood health. Furthermore, the high prevalence of LBW and its complications and the need for the identification of its determinants, especially with the view to social determinants of health on the one hand, and the emphasis of the WHO Commission on research into determinants in 2010 on the other, warrant greater attention to lower social classes.

As noted, good social and family support has positive effects on the health and birthweight of the infant through promotion of a healthy lifestyle, and reduction of maternal stress and anxiety and so on, either directly

or as an intermediate.^{45,46} This is the most powerful coping factor for successfully and easily dealing with stressful situations at times of conflict, including during pregnancy, which helps the woman to tolerate problems more easily.^{53–55} Accordingly, with an emphasis on this psychosocial factor, the occurrence of many adverse pregnancy outcomes, such as LBW can be prevented.

Considering the high rate of LBW and the effect of stressful socioeconomic conditions on this undesirable outcome, it is recommended that support groups be formed to support pregnant women, to encourage families, to raise their knowledge, to improve quality of life and reduce maternal stress, and subsequently to reduce

undesirable pregnancy outcomes. Moreover, reproductive health managers should design programs to enhance men's participation to help improve pregnant women's quality of life, design internet and information sites to support pregnant women's needs, provide plans to improve stress control and interpersonal relationships through the use of expert advice in order to improve quality of life, and thus reduce stress in women, which ultimately leads to healthy and happy children in joyous families.

Study strengths

This study both addressed the role of psychosocial factors in LBW clinically and biologically, and emphasized the role of support, and the importance of this social factor.

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Disclosure

The authors declare no conflicts of interest.

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